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SOME QUANTITATIVE ASPECTS OF THE INSTRUCTIONAL PROCESS.

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THE DATA FROM THE SEVERAL STUDIES ANALYZED IN THIS REPORT HAVE BEEN COLLECTED AS FART OF AN ON-GOING EFFORT TO IMPLEMENT THE ABT ASSOCIATES' EDUCATION COST EFFECTIVENESS INSTRUCTIONAL PROCESS SUBMODEL, WHICH IS DEVELOPING TECHNIQUES TO EVALUATE THE QUANTITATIVE, CAUSE-AND-EFFECT RELATIONSHIP BETWEEN THE INSTRUCTIONAL PROCESS AND SCHOLASTIC ACHIEVEMENT. THE SUBMODEL AND OTHERS OF THE OVERALL EDUCATIONAL COST EFFECTIVENESS MODEL, DEVELOPED IN RESPONSE TO THE FINDINGS OF "EQUALITY OF EDUCATIONAL OPPORTUNITY" (THE COLEMAN REPORT), DEVELOP TECHNIQUES TO EVALUATE THE RELATIVE SCHOOL, STUDENT, AND COMMUNITY EFFECTS, AND ASSOCIATED EVENTS OF TITLE I PROGRAMS FOR THE DISADVANTAGED. THE ANALYZED STUDIES IDENTIFY SPECIFIC QUANTITATIVE DATA ON (1) COMMUNITY AND HOME ENVIRONMENT VERSUS ACHIEVEMENT, AND (2) SCHOOL ENVIRONMENT VERSUS ACHIEVEMENT. ALSO, TO DEMONSTRATE THE RELATIVE MAGNITUDES OF ENVIRONMENTAL VERSUS INSTRUCTIONAL FACTORS, A SERIES OF CALCULATIONS ARE MADE FROM CORRELATIONS IN "EQUALITY OF EDUCATIONAL OPPORTUNITY." IT IS FELT THAT OBTAINING THIS QUANTITATIVE DATA IS DIFFICULT BECAUSE ONLY A FEW AVAILABLE STUDIES DEAL EXCLUSIVELY WITH SCHOOL ENVIRONMENT VERSUS ACHIEVEMENT AND THAT MUCH OF THIS USEFUL INFORMATION IS LIMITED BY RESEARCHERS' CONCERN FOR THE METHODOLOGY OF A STUDY RATHER THAN ITS RESULTS. (EF)

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SOME QUANTITATIVE ASPECTS OF THE INSTRUCTIONAL PROCESS

Recent emphasis on equal educational opportunity has resulted in an increased need for knowledge about the nation's educational systems. Perhaps the most comprehensive study of equal educational opportunity is contained in Equality of Educational Opportunity.[1] This publication examines subjects such as segregation in the public schools, the schools and their characteristics, achievement in the public schools, and the relation of achievement to school characteristics.

A very important fact highlighted by the publication is that certain segments of the population consistently achieve at lower levels than the national norm throughout their school lives. Moreover, the achievement gap increases with school grade.

This fact has led to a number of other efforts in educational research, one of which is the Abt Associates' Education Cost-Effectiveness Model.* The purpose of the Education Cost-Effectiveness Model is to develop techniques to evaluate the relative school, student, and community effects and associated costs of alternative Title I programs for the disadvantaged. The overall model consists of five submodels:

1. School
2. Instructional Process
3. Community Interactions
4. Costs
5. Effectiveness

Of primary interest here is the instructional process submodel. It attempts to simulate the interaction between student and his school environment. Implementation of the model and, in a parallel effort, an overall evaluation of the instructional process, requires detailed quantitative data relating changes in student achievement to changes in some

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(1) Coleman, James S., et al., Equality of Educational Opportunity, Office of Education, U.S. Department of Health, Education, and Welfare, U.S. Government Printing Office (Washington, D.C.: 1966).

*Work currently being performed under contract with U.S. Office of Education (OEC 1-6-001618-1618).

aspect of the school environment. Hopefully, reports from the states' boards of education on the results of use of Title I funds will provide some of this information, but certainly not all of it.

This note gives the preliminary results of an on-going effort at ferreting out these quantitative data from various literature sources. Sources of information used were libraries, Educational Research Information Center (ERIC), Science Information Exchange, Cooperative Research Project, further analysis of information found in Equality of Educational Opportunity, and suggestions from colleagues on the subject. An annotated bibliography summarizes the results of the inquiries.

A first observation is that a number of studies have been and are being conducted, but results are not yet available for review. Secondly, of those available, very few are found to deal exclusively with school environment versus achievement. Finally, really useful information is further limited by the researchers' tendency to dwell in the methodology of research, rather than its results.

Community and Home Environment Versus Achievement

An example of community environment versus achievement is contained in The Disadvantaged and Potential Dropout.[2] In this publication by Gowan, et al., an article reprinted from the Journal of Secondary Education relates the efforts of Young (1964) in his study of community predictors of school retention rate. In an attempt to determine which of the socio-economic forces operating in a community most strongly affects a school's retention rate, data were collected in communities with a population range of 25,000 to 65,000, located in the nine northeastern states.

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(2) Gowan, John C., The Disadvantaged and Potential Dropout, Charles C. Thomas, publisher (Springfield, Illinois: 1966).

The states included were Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The variables used in the study were both instructional (school oriented) and environmental (home and community). Some of the variables selected for the study and their corresponding correlations with school retention rate are displayed in Table I.

TABLE I

Correlations Between Socio-Economic Variables
And School Retention Rate

Variables Studied	Type	Correlations
Per capita pupil expenditure	Instructional	0.31**
Median teacher salary	Instructional	0.34*
Per capita value of school property	Instructional	0.21
Median school grade reached by adults in the community	Environmental	0.38*
Median monthly rentals in the community	Environmental	0.43*
Mean income in the community	Environmental	0.40*
Percentage of professional workers in the employed population	Environmental	0.38*
Population size of the community	Environmental	-0.28**
Percentage of overcrowded dwelling units	Environmental	-0.33**
Percentage of home ownership	Environmental	0.37*

*One percent level of significance

**Five percent level of significance

After the means, the standard deviations, and the matrix of correlations for the school and community variables and school retention rate had been developed, the data were employed to determine the best prediction equation for school retention rate. As finally stated, the equation reads:

Retention Rate (percent) = 91.574 + 0.054 MMR ***
(Median Monthly Rental)

Standard Error of Estimate ± 2.105

The equation was applied to the high schools of twenty-one communities not involved in the development of the equation. The mean retention rate for these communities was approximately ninety-six percent (Dropout rate = four percent). In seventeen of these communities (eighty-one percent), the prediction was within the standard error of estimate.

Highly correlated with the effect of home environment is the motivational relationship with achievement. An article in the Journal of Educational Psychology relates this case:(3)

> "Separate samples of 233 Negro and 515 Caucasian high school students of both sexes, randomly selected to represent the wide range of socio-economic environments, were tested as to verbal aptitude, academic achievement, and academic motivation. Except for Negro males, both samples obtained significant correlations between verbal aptitude and achievement, but academic-motivation tests (the M scales) correlated significantly with achievement for all groups of interest."

***Note: Although the equation implies a high correlation between community-oriented variables and school retention rate, instructional variables are of the same order of magnitude in correlations as the environmental variables.

(3) Green, Robert L., "Negro Academic Motivation and Scholastic Achievement," Journal of Educational Psychology, Vol. 56, No. 5, (1965) pages 241-243.

The following table gives the results of these tests:

TABLE II

Correlations Between Aptitude and M-Scale Subtests With Grade-Point Average as a Function of Race and Sex

Sample		Aptitude & M-Scale Subtests Correlated with Grade-Point Average (GPA)					
Race & Sex	Verbal Aptitude	GSCI	HTI	PJCS	WRL	M Total	N
Negro							
Male	-.01	.26	.14	.30	.36	.37	104
Female	.25	.46	.40	.34	.64	.55	129
White							
Male	.62	.50	.42	.32	.51	.50	254
Female	.21	.21	.29	.18	.34	.43	261

Note: Abbreviations used: GSCI, Generalized Situational Choice Inventory; PJCS, Preferred Job Characteristics Scale; HTI, Human Traits Inventory; WRL, Word Rating List; M, Michigan State M Scales--objective measure of academic motivation; M total, correlation of total Michigan State M Scales test score with Grade-Point Average; N, total number of participants for each category; GPA, Grade Point Average.

The correlations between achievement (GPA) and aptitude for both races and sexes are shown in Table II. As indicated in this table, there is no correlation between verbal aptitude and GPA for Negro males despite the significant correlation between verbal aptitude and GPA for Negro females. The self concept--Word Rating List (WRL)--is the best single predictor of achievement for the Negro males and females and white females, while verbal aptitude is the best predictor for white males. The most important finding of the study was the lack of correlation between aptitude and achievement (-0.01) for Negro males. This is noteworthy in light of the comparatively high correlation for white males (0.62).

School Environment Versus Achievement

Selected from the reports which dealt with variables inside the school are two teacher related studies: Teacher Influence, Pupil Attitudes, and Achievement,[4] and Classroom Interaction, Pupil Achievement and Adjustment in Team Teaching as Compared with the Self-Contained Classroom.[5] The first study describes a classroom interaction model and includes a statistical analysis of teacher verbal influence versus student achievement. A trained observer interprets and scores a teacher's classroom behavior in terms of his direct and indirect influence. Direct influence may include lecturing, giving directions, and criticizing or justifying authority. Examples of indirect influence are accepting feeling, praising or encouraging, accepting or using ideas of students, and asking questions. Student reactions may be response, initiation, and silence or confusion. Data are tabulated separately for different activity periods during the school day, thereby creating a means of measuring teacher flexibility. This is measured by noting the ratio of indirect influence (I) to direct influence (D) in one activity period and comparing it with the corresponding ratio in other activity periods.

In Table III, below, the achievement of seven indirect classes is compared with that of eight direct in social studies classes. The scores have been adjusted for initial ability and the difference between means found significant beyond the 0.01 level using a critical ratio test.

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(4) Flanders, Ned A., Teacher Influence, Pupil Attitudes and Achievement, Cooperative Research Monograph No. 12, U.S. Government Printing Office (Washington, D.C.: 1965).

(5) Lambert, P., et al., Classroom Interaction, Pupil Achievement, and Adjustment in Team Teaching as Compared with the Self-Contained Classroom, Cooperative Research Project No. 1391, University of Wisconsin (Madison, Wisconsin: 1964).

TABLE III

Means and Variance of Adjusted Final Test by IQ Group

Teacher Style	IQ Group (Mean)	Adjusted Score	Variance
Indirect (7 Classes)	High (124.7)	38.7	13.3
	Average (110.9)	36.3	30.5
	Low (94.8)	33.0	38.2
	All Ss	36.4	34.2
Direct (8 Classes)	High (123.3)	35.7	18.9
	Average (109.2)	33.8	31.2
	Low (93.8)	31.1	38.4
	All Ss	33.4	33.4

In those social studies classrooms in which the teacher had a higher I/D ratio, the students scored higher on a measure of achievement controlled for initial ability. There is little evidence to support the notion that the achievement of students whose IQ's are above-average, average, or below-average is differentially affected by exposure to direct or indirect influence; i.e., all groups benefited from the higher I/D ratio.

The second study (5) uses these same techniques of quantifying teacher's verbal influence with an additional comparison between self-contained and team teaching methods by accessing their affect on achievement. The schools used in this study are both located in Madison, Wisconsin. The experimental design included three organizations: The Washington School Self-Contained (WSC), the Washington School Team (WT), and the Longfellow School Self-Contained (LSC). The Washington School Team organization consisted of two teams, each composed of a team leader, a regular teacher, two graduate

interns, and a half-time instructional secretary. The Longfellow School organization was incorporated in the experiment to measure possible contamination of variables in Washington School. Figure 1 shows results of the total achievement by grade and organization.

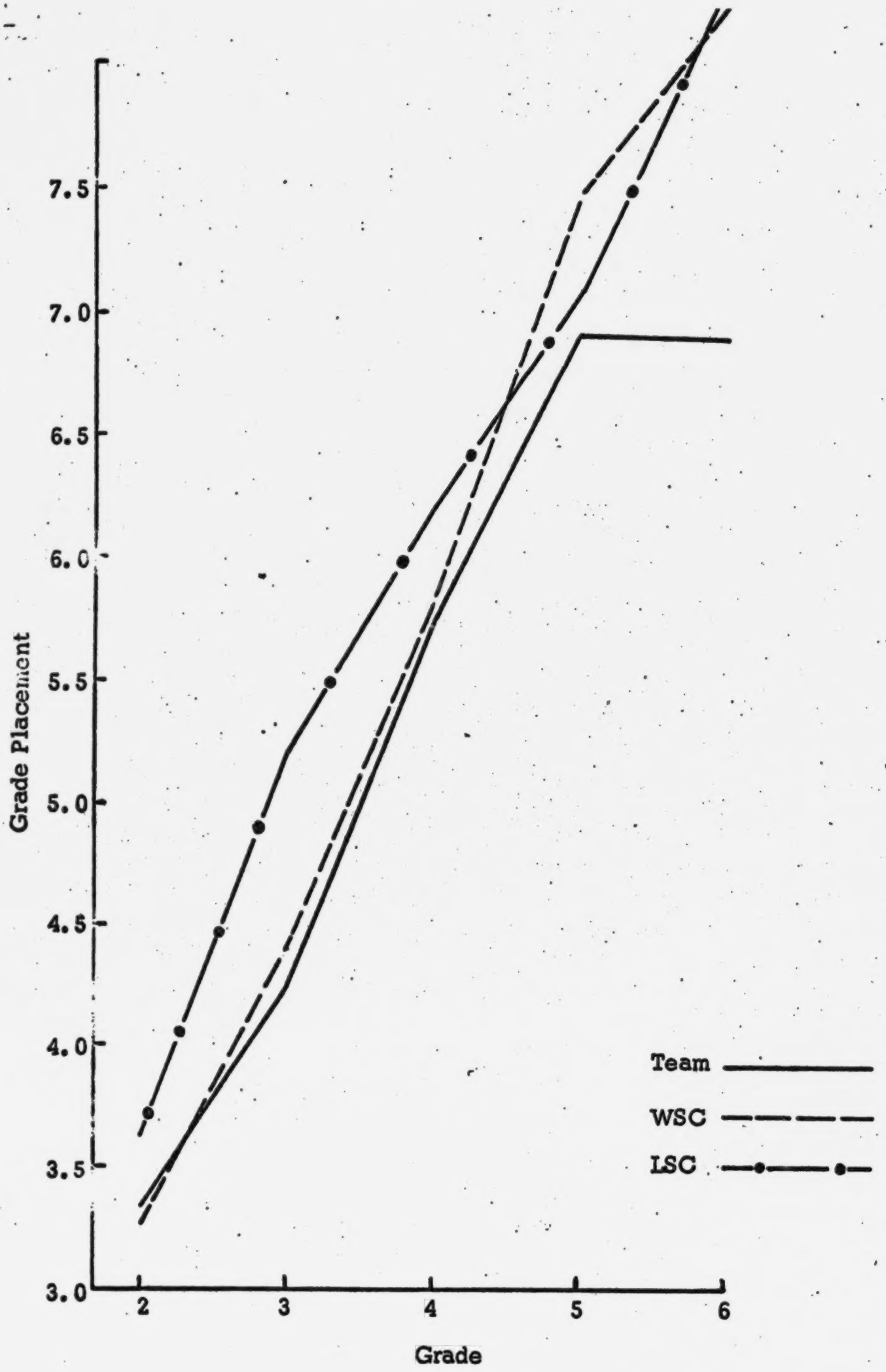

Figure 1: California Achievement Test: Mean grade placements for total achievement post-test by grade and organization; 1961-1962.

Comparison of Relative Weights of Environmental and Instructional Factors

The foregoing has shown the scarcity of published information which, in any quantitative manner, shows a significant relationship between scholastic achievement and the instructional process. Intuitively, one feels there should be a measurable cause-and-effect relationship. Better instruction should result in better achievement, all other factors being constant. The problem is that all other factors are not only not constant--their magnitude overshadows the instructional factors and tends to make those elusive relationships even harder to find.

The important influence of environmental factors with respect to achievement is stressed in Equality of Educational Opportunity. "The larger part of school-to-school variation in achievement," reports this publication,[6] "appears to be not a consequence of effects of school variation at all, but of variations in family backgrounds of the entering student bodies."

To demonstrate the relative magnitudes of environmental versus instructional factors, a limited series of calculations was made from correlations published as an appendix to the survey. The methodology was as follows:

1. The list of sixty variables actually used in correlations was chosen as the data basis.

2. Variable 2 of this list, giving a measure of student verbal achievement, was selected as the dependent variable.

3. Three instructional variables were arbitrarily chosen after a study of the correlations. These three probably show the instructional influence to as great a degree as any others that could have been chosen.

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(6) Op.cit., page 296.

They are:

(a) Variable 17, Teacher Verbal Ability Score

(b) Variable 32, Principal and Superintendent College Attendance

(c) Variable 38, Per Pupil Instructional Expenditure

This selection also serves to reflect separate influences of teacher quality, administration, and actual funding.

4. Variable 51, School Verbal Mean Score, was selected to be held constant in obtaining the partial relationship of achievement to each of the set of three variables. The correlation $R_{12.3}$ was computed according to the formula[7]

$$R_{12.3} = \frac{r_{12} - (r_{13})(r_{23})}{\sqrt{(1 - (r_{13})^2)(1 - (r_{23})^2)}} .$$

Here, r_{12} is the correlation of verbal achievement with a variable; r_{23} is the correlation of that variable with school verbal mean score; and r_{13} is the correlation of verbal achievement with school verbal mean score.

5. Finally, a multiple correlation of verbal achievement with three partialled instructional variables was made, using the method of Guilford (already cited) given on pages 406-409.

6. Next, three environmental variables were arbitrarily chosen after a study of the correlations. These are:

(a) Variable 10, Proportion of Students in School Owning Encyclopedia

(b) Variable 51, School Verbal Mean Score

(c) Variable 54, Average Number of White Students in School

These variables represent home socio-economic status and school environment.

7. Statistical operations were performed on the environmental variables as described in Paragraphs 4 and 5 for instructional variables. Here, Variable 17, Teacher Verbal Ability Score, was held constant for the partial correlations.

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(7) Guilford, J.P., Fundamental Statistics in Psychology and Education, McGraw-Hill (1956), p. 316.

8. The following Grade XII groups were chosen for analysis:
   (1) Mexican Americans
   (2) Puerto Ricans
   (3) Indian Americans
   (4) Oriental Americans
   (5) Negro, North
   (6) White, North
   (7) Negro, South
   (8) White, South

Indian American correlations were also run for grades IX and VI.

Table IV shows the partial correlations of verbal achievement to the instructional variables, holding constant the school verbal mean.

Table V shows the partial correlations of verbal achievement to the environmental variables, holding constant the teacher verbal ability score.

Table VI shows the multiple correlations of the dependent variable, verbal achievement, to three partialled instructional variables and three partialled environmental variables.

In Table VII, we observe relatively small values for multiple correlations of achievement with the arbitrarily selected group of three instructional variables. These correlations range as follows:

Low, Negro, North, XII, 0.0203
Median, White, North, XII, 0.0581
High, Indian Americans, XII, 0.1788

By contrast, the corresponding correlations with three environmental variables are 0.3151, 0.2864, and 0.6344, respectively. While there are no universally accepted rules for interpretation of these values, it will be generally accepted that the entire first set of correlations (instructional) shows little significance. Much more weight can be attributed to the second set (environmental factors).

A further computation was made to ascertain whether the insignificant multiple correlations of achievement with instructional variables is partly due to first, the limited number of independent variables; and second, their arbitrary selection. By inspection of the EOS data, two more variables were chosen. Again, these appeared to be the next most influential. They are:

Variable (14), Teacher College (Background)

Variable (58), School Math Courses

Using the five independent variables, multiple correlations were again computed as before. Some results are shown in Table VII.

TABLE IV

Partial correlations of verbal achievement (Variable 2) to three instructional variables, holding constant the school verbal mean (Variable 51).

Group and Grade		Variable 17 Teacher Verbal Ability Score	Variable 32 Princ. & Supt. College Attendance	Variable 38 Per Pupil Instr. Expend.
Mexican Americans	XII	.0250	-.0402	.0848
Puerto Ricans	XII	.0139	-.0430	.0120
Indian Americans	XII	.0196	-.0950	-.1523
Oriental Americans	XII	.0736	.0848	.0504
Negro, North	XII	-.0158	-.0116	.0035
White, North	XII	.0280	.0424	.0337
Negro, South	XII	.0248	.0245	.0324
White, South	XII	.0199	.0122	.0157
Indian Americans	IX	-.0184	-.0291	-.0196
Indian Americans	VI	.1141	.0822	-.0048

TABLE V

Partial correlations of verbal achievement (Variable 2) to three environmental variables, holding constant the teacher verbal ability score (Variable 17).

Group and Grade	Variable 10 Proportion Students Owning Encyclopedia	Variable 51 School Verbal Mean	Variable 54 Average White Students
Mexican Americans XII	.2575	.3767	.2724
Puerto Ricans XII	.3526	.4217	.2187
Indian Americans XII	.3226	.4475	.1446
Oriental Americans XII	.0813	.1037	.0125
Negro, North XII	.2036	.2726	.0890
White, North XII	.1709	.2704	.0411
Negro, South XII	.2466	.3089	.0076
White, South XII	.2016	.3094	-.0157
Indian American IX	.2819	.4287	.1830
Indian American VI	.1643	.4050	.0588

TABLE VI

Multiple correlations of verbal achievement with three partialled instructional variables (Table IV) and three partialled environmental variables (Table V).

		Multiple Correlations	
Group and Grade		Instructional	Environmental
Mexican Americans	XII	.0975	.3768
Puerto Rican	XII	.0446	.4578
Indian Americans	XII	.1788	.6344
Oriental Americans	XII	.0999	.1591
Negro, North	XII	.0203	.3151
White, North	XII	.0581	.2864
Negro, South	XII	.0443	.3541
White, South	XII	.0230	.3184
Indian Americans	IX	.0345	.5249
Indian Americans	VI	.1538	.4971

TABLE VII

Multiple correlations of verbal achievement with a set of three partialled instructional variables, extended to a set of five.

Group and Grade		Multiple Correlations	
		3 Variables 10 Own Encyclo. 51 Sch. Vbl. Mean 54 Avg. White Stu.	5 Variables 10 Own Encyclo. 51 Sch. Vbl. Mean 54 Avg. White Stu. 14 Tch. College 58 Math Courses
Mexican Americans	XII	.0975	.1483
Indian Americans	XII	.1788	.1802
Oriental Americans	XII	.0999	.1188
Negro, North	XII	.0203	.0262

SUMMARY

Current emphasis on equality of educational opportunity for the nation's children shows the need for new knowledge about how the educational system actually works. The existence of a significant inequality of educational achievement among various population groups has been demonstrated by a U.S. Government study.(1) Programs directed towards reducing this disparity are being energetically implemented under government sponsorship.

However, as shown in this note, very little knowledge in the way of quantitative, cause-and-effect relationships between instructional process and scholastic achievement, is available to the governmental and educational communities. The need for directed research in this area is, in the opinion of the writers, urgent; its ultimate value in improving the cost-effectivness of current educational programs will be high.

ANNOTATED BIBLIOGRAPHY

David, Martin, et al., Educational Achievement--Its Causes and Effects, Cooperative Research Project No. 812, University of Michigan, Survey Research Center (1961).

Detailed study of the effect of education on income, employment, advancement, and hence, economic welfare; and what determines how much education an individual gets. Also examines the extent to which education depends upon the parents' education and income. Gives statistics, statistical techniques used and results of the study.

Flanders, Ned A., Teacher Influence, Pupil Attitudes, and Achievement, Cooperative Research Monograph No. 12, U.S. Government Printing Office (Washington, D.C.: 1965).

The research reported in this monograph concerns the verbal statements of teachers as they occur in the spontaneous interaction of the classroom. A system of classroom interaction analysis, a method of recording and analyzing teacher statements, is explained. A theory of teacher influence or, some hypotheses of teacher influence, are developed and tested. The data were obtained from research carried out in the Minneapolis and St. Paul public schools before March 1957 and after March 1958. Additional data came from research in Wellington, New Zealand.

Gowan, John C., and Demos, George D., The Disadvantaged and Potential Dropout, Charles C. Thomas, publisher (Springfield, Illinois: 1966).

A compilation of forty-five articles related to studies of the dropout problem. Chapter 2 (Definition, Statistics, Identification) is highlighted by two very interesting articles written by Donald A. Davis (An Experimental Study of Potential Dropouts) and Nathan Young (Community Predictors of School Holding Power). Davis examines what would happen if some potential dropouts were identified and a serious attempt were made to make friends with these students at the beginning of the year, to take a personal interest in them, to convince them that they are liked and wanted at the school, to involve the staff in recognition of the problem and its ramifications, and even to modify the curriculum, if necessary, for such students. Young examines the socio-economic forces operating in a community in order to determine the degree to which these forces could be used as predictors of high school holding power. A basic result is his equation for high school holding power.

Green, Robert L., "Negro Academic Motivation and Scholastic Achievement," Journal of Educational Psychology, Vol. 56, No. 5 (1965), pp. 241-243.

Samples of Negro and Caucasian high school students are selected and their verbal aptitude, academic achievement, and academic motivation tested. An interesting result was that Negro males showed no relationship between verbal aptitude and achievement.

Kornrich, M., Underachievement, Charles C. Thomas, publisher (Springfield, Illinois: 1965).

A compilation of fifty-one articles related to studies of underachievement. One very interesting article was written by James S. Coleman. The research being reported is an attempt to examine the status systems of the adolescent communities in ten high schools and to see the effects of these status systems upon the individuals within them. The ten schools are all in the Midwest. They include five schools in small towns, one in a working-class suburb, one in a well-to-do suburb, and three schools in cities of varying sizes. Results are expressed in very interesting graphs and plots of relevant variables. Another article of interest is one written by Bernard C. Rosen. He discusses differences in vertical mobility rates of some racial and ethnic groups in terms of their dissimilar psychological and cultural orientations--achievement motivation, achievement values, and educational occupational aspirations which constitute an "Achievement Syndrome."

Lambert, P., et al., Classroom Interaction, Pupil Achievement, and Adjustment in Team Teaching as Compared with the Self-Contained Classroom, Cooperative Research Project No. 1391, University of Wisconsin, (Madison, Wisconsin: 1964).

This report concerns the kinds of teaching and learning relationships, or forms of classroom interaction in the team teaching arrangement, and the differences between these and traditional classroom interaction. A related question studied is student adjustment and student achievement in the team structure as compared to the self-contained classroom. Results are presented in graphic and tabular form. A section is included to review or familiarize the reader with the statistical techniques used.

Quick, E. J., New Opportunities for the Culturally Disadvantaged, The Canadian Education Association (Toronto, Canada: 1965).

A composite report by Canadian educators who visited and studied compensatory programs for the culturally disadvantaged in fifteen large cities of the United States. Most useful as a summary to the type of compensatory programs being conducted in large cities throughout the country. Representative topics of discussion were the "Higher Horizons" program in New York City, Buffalo's Able Project, Programs for Culturally Disadvantaged in the Inner City of Baltimore, and the Golden Gate to Learning--San Francisco.

Riessman, F., The Culturally Deprived Child, Harper and Row (New York: 1962).

The author examines many aspects of the subject and attempts to develop new approaches to problems of the underpriviledged. Two very outstanding chapters in the book are "Higher Horizons: A Critical Evaluation" and "Ideas for Action."